Comparative Studies on the Stomachal Plates and Crystalline Style—IV. On the Crystalline Style of *Dolabella scapula*

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I. Introduction

In previous paper¹⁾, the authors presumed the presence of the crystalline style also in *Dolabella* on the assumption that the stomachal plates are homologous to the gastric shield in bivalves.

So far the style has been found in many bivalves and a few gastropods, and considered to be absent or not studied in another molluscs except some pteropods. In this respect, YONGE²⁾ gave a list of the distribution of the style in gastropods. Among opisthobranchs, the style was found only in some species of pteropods by MEISENHEIMER³⁾ and YONGE⁴⁾. This finding is very interesting. Namely, it is notable that YONGE⁴⁾ described the presence of the stomachal plates and a crystalline style in a pteropod *Creseis*, although he did not pay any attention on the correlation between the above-mentioned two structures. This description gave us an important suggestion.

To confirm our assumption, we examined the digestive system of *Dolabella* thoroughly and fixed our eyes upon the *blind-sac*, whose origin and function remained unknown, whereas its presence has been known from old. After detailed examinations, the authors concluded that the blind sac is nothing but the style sac and discovered a crystalline style in it.

Here, the relations among these organs, such as crystalline style, style sac, blind sac, gastric shield and stomachal plates, may be illustrated as follows. (next page)

II. Structure of blind sac

The blind sac of *Dolabella scapula* is a greyish green and U-shaped blind tube. The most part lies enclosed in mid-gut gland, but the closed end is exposed on the surface. The sac opens to a cavity, in which the ducts of mid-gut gland centre.

Diagrammatic figures of digestive organs of three molluscs. A. *Donax sp.*,

B. *Creseis acicula* (after YONGE), C. *Dolabella scapula*

bl.s. blind sac; cr.sty. crystalline style; div. diverticulum; gast.sh. gastric shield; giz. gizzard; int. intestine; m.g.g. mid-gut gland; oes. oesophagus; st. stomach; st.pl. stomachal plate; sty.s. style sac.

By two typhlosoles, the internal chamber of the sac is divided distinctly into two cavities in its total length, which unite at the closed end. A crystalline style lies in the one cavity and the other is vacant.

In morphological and histological observations, the crystalline style containing cavity (C.C.) shows much resemblances to the style sac. The relation between C. C. and the another hollow cavity (H.C.) may be compared with that of the style sac and mid-gut as observed in *Lampsillis*⁵⁾, *Mya*⁶⁾, *Ostrea*⁷⁾, *Crepidula*⁸⁾ and others.

The C.C. epithelium is very characteristic; it is composed of regularly situated, thick and three times taller glandular cells than those of the another cavity epithelium. The glandular cells have much dense cilia of same length. The cell plasm is stained faintly with eosin and globular nuclei lie lean to the cell bottom. These features indicate the condition of active secretion of the cells.

Scattered here and there, groups of glandular cells like taste-bud dot the epithelium. The internal fibrillar apparatus and intraepithelial canal, which were found first by MACKINTOSH⁹⁾ in *Crepidula* and later by YONGE⁷⁾ in *Ostrea*, were not observed in this animal.

The H.C. epithelium is composed of dense goblet and cylindrical cells, which are stained well with dyes. The cells are shorter and differ apparently from those of C.C. The epithelial cells of typhlosoles are very low and have very short cilia. The epithelium is interwoven with much regularly situated mucous cells.

A distinct border line exists among both epitheliums of typhlosoles and C.C., whereas the former changes gradually to H.C. epithelium. Two typhlosoles show

no remarkable difference each other, which was observed in the case of *Mya*⁶⁾ and *Ostrea*⁷⁾. Typhlosoles seem to contain considerable intercellular fibres.

Attaching to the blind sac epithelium, there lies connective tissue, which contains much vesicular connective fibres especially in typhlosoles. In most outer layer, oblique and longitudinal muscles develop well.

III. Crystalline style

A crystalline style lies in the centre of C.C. in its length. The style is a cylindrical rod, which is slender gradually to the closed end and has no concentric circle as observed on the style of *Mya*. The axial part shows granular structure and stained dark red with heamatoxylin-cosin. On the other hand, the marginal part is stained faint pink with above dyes and composed of homogenous gelatinous substance, which involves or adheres fragments of food.

IV. Enzyme in the style

Amylase was examined on the 10% water extract of the style as described in previous paper⁹⁾, and proved to be inactive or very weak if any.

V. Discussion

EALLES¹⁰⁾ described on *Aplysia* that the food materials from the stomach pass down the left side of the blind sac and pass up to the intestine through the right cavity. However, the blind sac of *Dolabella* seems to perform little function in digestion, judging from the situation, structure and size of the sac. The lack of amylase in the style may support this consideration. However, the possibility exists that the presence of food fragments in the style may be due to a very small circulation of strayed foods as EALLES considered.

Although the crystalline style of *Dolabella* must be considered to be degenerated or undeveloped, the presence may throw much light on the comparative physiology of mollusc digestion. It is interesting that the stomachal plates acquired the similar function as the crystalline style of bivalves, in contrast to the impotent style in *Dolabella*.

The resemblance of H.C. to the mid-gut of bivalves seems to be interesting and offer some biological problems.

VI. Summary

1. The authors discovered the presence of a crystalline style in the blind sac of *Dolabella* for the first time.

2. The blind sac is composed of two cavities and the one resembles to the style sac of bivalves.

3. The relations among the crystalline style, style sac, blind sac, gastric shield and stomachal plates and the physiological meanings of these organs were discussed.

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Fig. 1. Transverse section of blind sac ($\times 18$)

Fig. 2. Transverse section of crystalline style ($\times 180$)

Fig. 3. Epithelium of style sac
(cs, crystalline style; ct, connective tissue; ep, epithelium) ($\times 120$)